Journal of the Society of Arts.

FRIDAY, MAY 9, 1856.

TWENTY-FIRST ORDINARY MEETING.

WEDNESDAY, MAY 7, 1856.

The Twenty-first Ordinary Meeting of the One Hundred and Second Session was held on Wednesday, the 7th inst., John Thwaites, Esq., Chairman of the Metropolitan Board of Works, in the Chair.

The following Candidates were balloted for, and duly elected Ordinary Members:—

Daines, John Benjamin.	Harvey, Capt. John, R.N.
Dunn, Thomas.	Niblet, Alfred Newsom.
Eagland, Thomas.	Sharer, Thomas.
Edgington, Benjamin.	Warren, Henry George.
Hanmer, Lieut. F. H.	Wilkinson, George.

The following Institution has been taken into Union since the last announcement:—

414. Swanage, Literary and Scientific Institution.

Previous to the reading of the Paper the Secretary called attention to some specimens prepared by Barratt's patent process for hardening and preserving soft stone, &c. The process consists in filling the pores of soft stone and other bodies of a like nature with preparations of sulphur under heat. Caen, Bath, and other soft stones, being first worked and carved, can be hardened and made weather-proof, and it is said, at a small cost. The stone thus prepared has the advantage of preserving its tint uninjured by damp or a smoky atmosphere. Modifications of this process, whereby the stone or other material is coloured by chemical preparations, as well as hardened, produce representations of black, purbeck, and other marbles, suited for interior decorative purposes, and various compositions, when moulded and submitted to the process, can at a low cost be used instead of stone. Bronze can also be imitated, so that it requires an experienced eye to detect the imitation. A solution of sulphur and gutta percha may be applied to the exterior of buildings constructed of soft stone or other porous materials, so as to harden and render them durable and waterproof. This solution is applied somewhat in the manner of a paint, and in a short time after application it becomes hard, without discolouring the material.

The paper read was—

FIRES: THE BEST MEANS OF PREVENTING AND ARRESTING THEM; WITH A FEW WORDS ON FIRE-PROOF STRUCTURES.

By James Braidwood, Assoc. Inst. C.E., Superintendent of the London Fire Brigade.

I have been requested by the Council of the Society of Arts to send them some information as to "Fires: the best means of preventing and arresting them; with a few words on fireproof structures." It is with great diffidence that I attempt a subject of such importance to the community, not only from my inability to do it justice in writing, but from the excessive difficulty of making each person comprehend the necessity of being sufficiently careful, due care being the best prevention against fire, as well as against many other evils.

To prevent fires it is necessary to consider what are the principal causes of such calamities. These may be classed under several heads:—

1. Inattention in the use of fires and lights.
2. Improper construction of buildings, &c.
3. Furnaces or close fires for heating buildings, or for mechanical purposes.
4. Spontaneous ignition.
5. Incendiarism.

There is little to be said on the first head which is not well-known to most masters of houses or other establishments, but the difficulty is, to keep up their attention or that of those under them. Some years ago, upwards of £100,000 were lost, through the partner of a large concern lighting gas with a piece of paper, which he threw away, and thus set fire to the premises, although it was a strict rule in the place that gas should only be lighted with tapers, which were provided for that purpose. In one department of a great public institution, it was, and is still, a rule that only covered lights should be carried about, and for that purpose four lanterns were provided; yet, on inquiry some time back, it was found that only one was entire, the other three being broken—one having lost two sides and the top; still they were all used as covered lights.

The opportunities for inattention to fires and lights are so various that it is impossible to notice the whole. Incautiously approaching window and bed curtains with a light, and airing linen before the fire, are almost daily causes of fire in London, and some of the most distressing cases of loss of life have originated from these and similar causes. Children playing with fire is also another constant cause of fire, and frequent loss of life. The dresses of females taking fire adds very much to the list of lives lost by fire, if it does not exceed all the other causes put together. Taking off the burning coals from a fire, and laying them on the hearth, also causes fires occasionally. Reading in bed by candle-light is another source of the same evil. A very serious annual loss is also caused by want of due care in hanging up or removing the goods in linen-drapers' shop windows when the gas is burning. Flues taking fire often result in mischief, and it is believed that many serious fires have arisen from this cause, which can hardly be called accidental, as if flues are properly constructed, kept moderately clean, and fairly used, they cannot take fire.

From what has been said, it will be seen that care and attention may do a very great deal towards the prevention of fire, and consequent loss of life. It is very easy to make good rules, and keep them for a time, after having been alarmed by some serious loss of property or life, but the difficulty is to maintain constant attention to the subject. The most evident plan for effecting this seems to be, for the masters thoroughly to examine and consider the subject at certain stated periods, not too far apart, and to constantly warn their domestics, workmen, or others, of the danger of the improper use of fire and lights.

One of the greatest preventives of carelessness in the use of fires and lights would be a legal inquiry in every case, as it would not only show the faults that had been committed, and thus warn others, but the idea of being exposed in the newspapers would be another motive for increased care. This plan has been adopted in New York, and the reports of the proceedings of Mr. Baker, the "Fire Marshall," show that the inquiries there made have led to most useful results. Mr. Payne, the coroner, held inquests on fires in the City some years ago, but the

authorities would not allow his expenses, and, therefore, they were given up, although believed to be highly advantageous in explaining accidental and other causes of fire.

The improper construction of buildings more generally assists the spread than is the original cause of fires, although laying hearths on timber, and placing timber too near flues, are constant causes of fire, and it is believed that many melancholy occurrences have arisen from these and similar sources. It is true the Building Act forbids all such proceedings, but the District Surveyors do not seem to have sufficient power, or be able to pay sufficient attention to such matters, as they are constantly met with at fires. A very flagrant case of laying a hearth on timber was lately exposed by a fire in the City. Due notice was given of the circumstance, but no further attention was paid to the matter than to make the proprietor construct the floor properly, although the Act gave power to fine for such neglect. This omission is to be regretted, as there could not have been a better case for warning others; it occurred in a very large establishment, and the work was done by one of the first builders in the City. Had this fire taken place in the night and gained some head, it would have been very difficult to have ascertained the cause. As the premises were situated a serious loss of life might have occurred, the apartment in which the fire originated being the only means of retreat which 10 or 12 female servants had from their bed-rooms.

The Building Acts, up to about the year 1825, by insisting upon party walls and other precautions, were invaluable for the prevention of the spread of fires. By them no warehouse was permitted to exceed a certain area. From the year 1842, the area has been exchanged for a specified number of cubic feet. But since 1825, a class of buildings has arisen of which there are now considerable numbers in the City, called Manchester or piece goods warehouses, which somehow, up to the 1st of January last, have been exempted from the law restricting the extent of warehouses, on the plea that they are *not* warehouses, because "bulk is broken" in them, although it is thoroughly understood that the legislature intended by the Act to restrict the amassing such a quantity of goods under one roof as would be dangerous to the neighbourhood.

It is necessary to state here, that the intensity of a fire, and the risk of its extending to other buildings, depends, *ceteris paribus*, on the cubic contents of the building which takes fire. Manchester and piece goods warehouses have for some time past been built of unlimited size, sometimes equal to twenty average houses. This is pretty nearly the same as if that number of houses were built without party walls, only that it is much worse, for the whole mass generally communicates by well holes and open staircases, and thus takes fire with great rapidity, and, from the quantity of fresh air within the building, the fire makes much greater progress before it is discovered. By this means the risk of fire in the City has been greatly increased, not only to such warehouses themselves, but to the surrounding neighbourhood, for it is impossible to say how far fires of such magnitude may extend their ravages under untoward circumstances, there being at present no preventive power in London capable of controlling them. To provide such a power would be a very costly business.

Such buildings are also against the generally received rule, that a man may burn himself and his own property, but he shall not unduly risk the lives and property of his neighbours.

The Building Act, which became law on the 1st January last, is likely to repress, to a certain extent, this great evil, unless its meaning be subverted by some such subterfuge as destroyed the efficiency of the last one. But what is to be done with those which are already built? It may seem tedious to dwell so much on this subject, but it appears to be a risk which is not generally much thought of, though it is of the most vital importance to the safety of London. It is very desirable that the metropolis should take warning by the experience of Liverpool, without going through the fiery ordeal which the latter city did.

From 1838 to 1843, £776,762 were lost in Liverpool by fire, almost entirely in the warehouse risks. The consequence was, that the mercantile rates of insurance gradually rose from about 8s. per cent. to 30s., 40s., and, it is said, in some cases, to 45s. per cent. Such premiums could not be paid on wholesale transactions, therefore, the Liverpool people themselves obtained an Act of Parliament, 6 and 7 Vic., cap. 109, by which the size and height of warehouses were restricted, party walls were made imperative, and warehouses were not allowed to be erected within 36 feet of any other warehouse, unless the whole of the doors and window shutters were made of *wrought iron*, with many similar restrictions. This Act applied to warehouses already built as well as to those to be built, and any tenant was at liberty, after notice to his landlord, to alter his warehouse according to the Act, and to stop his rent till the expense was paid. Another Act, 6 and 7 Vic., cap. 75, was also obtained, for bringing water into Liverpool for the purpose of extinguishing fires and watering the streets *only*. It is supposed that the works directed, or permitted by these two Acts, cost the people of Liverpool from £200,000 to £300,000. Shortly after these alterations had been made, the mercantile premiums again fell to about 8s. per cent.

There is another very common cause of fire, which seems to come under the head of construction, viz., covering up a fireplace when not in use with wood or paper and canvass, &c. The soot falls into the fireplace, either from the flue itself, or from an adjoining one which communicates with it. A neighbouring chimney takes fire; a spark falls down the blocked up flue, sets fire to the soot in the fire-place, which smoulders till the covering is burned through, and thus sets fire to the premises.

The danger from furnaces or close fires, whether for heating, cooking, or manufacturing purposes, is very great, and no flue should be permitted to be so used, unless it is prepared for the purpose. The reason is, that in a close fire the whole of the draught must pass through the fire. It thus becomes so heated that, unless the flue is properly built, it is dangerous throughout its whole course. In one instance of a heating furnace, the heat in the flue was found to be 300°, at a distance of from 40 to 50 feet from the fire. In open fireplaces the quantity of cold air carried up with the draught keeps the flue at a moderate heat, from the fire upwards, and unless the flue is allowed to become foul, and take fire, this is the safest possible mode of heating.

Heating by hot air, steam, and hot water are objectionable. First, because there must be a furnace and furnace flue, and the flue used is generally that built for an open fire only. And second, the pipes are carried in every direction, to be as much out of sight as possible. By this means they are constantly liable to produce spontaneous ignition, for there appears to be some chemical action between heated iron and timber, by which fire is generated at a much lower temperature than is necessary to ignite timber under ordinary circumstances. No satisfactory explanation of this fact has yet been given, but there is abundant proof that such is the case. In heating by hot water pipes, those hermetically sealed are by far the most dangerous, as the strength of the pipes to resist the pressure, is the only limit of the heat to which the water and of course the pipes may be raised. In some cases a plug of metal which fuses at 400° is put into the pipes, but the heat to which the plug is exposed will depend very much on where it is placed, as, however great may be the heat of the exit pipe, the return pipe is comparatively cool. But even where the pipes are left open, the heat of the water at the furnace is not necessarily 212°. It is almost needless to say that 212° is the heat of boiling water, under the pressure of one atmosphere only; but if the pipes are carried sixty or seventy feet high, the water in the furnace must be under the pressure of nearer three atmospheres than one, and, therefore, the heat will be proportionately increased. Fires from pipes for heating by hot water have been known to take place

within twenty-four hours after first heating, and some after ten years of apparent safety.

The New Building Act prescibes rules for the placing steam, hot air, and hot water pipes at a certain distance from timber, but as it must be extremely difficult for the District Surveyors to watch such minute proceedings, it becomes every one who is anxious for safety, to see that the District Surveyors have due notice of any operation of this kind.

Another cause of fire which may come under this head is, the use of pipes for conveying away the products of combustion. Every one is acquainted with the danger of stove pipes, but all are not perhaps aware that pipes for conveying away the heat and effluvia from gas burners, are also very dangerous, when placed near timber. It is not an uncommon practice to convey such pipes, between the ceiling and the flooring of the floor above. This is highly dangerous. Gas burners are also dangerous when placed near a ceiling. A remarkable instance of this took place lately, where a gas burner set fire to a ceiling 28½ inches from it.

Another evil of furnaces is, that the original fireplace is sometimes not large enough to contain the apparatus, and the party wall is cut into. A most melancholy loss of life took place from this cause last winter. Perhaps it may be necessary to notice at this point, the use of gas, as it is becoming so very general. Gas, if carefully laid on, and properly used, is safer than any other light, so far as actually setting fire to anything goes, but the greater heat given out so dries up any combustibles within its reach, that it prepares them for burning, and when a fire does take place the destruction is much more rapid than in a building lighted by other means. Gas stoves also, from the great heat given out, sometimes cause serious accidents; in one instance, a gas stove set fire to a beam through a two-and-half inch York landing, well bedded in mortar, although the lights were five or six inches above the stone. This is mentioned to show that gas stoves require quite as much care as common fires. The heat given out by the gas also increases very much the risk of spontaneous ignition. This is believed to be a very fruitful cause of fires; but, unless the fire is discovered almost at the commencement, it is difficult to ascertain positively that spontaneous ignition has been the cause. Spontaneous ignition is generally accelerated by natural or artificial heat. For instance, where substances liable to spontaneous ignition are exposed to the heat of the sun, to furnace flues, heated pipes, or are placed over apartments lighted by gas, the process of ignition proceeds much more rapidly than when in a cooler atmosphere. Sawdust in contact with vegetable oil is very likely to take fire. Cotton, cotton waste, hemp, and most other vegetable substances are alike dangerous. In one case oil and sawdust took fire within sixteen hours; in others, the same materials have lain for years, until some external heat has been applied to them. The greater number of the serious fires which have taken place in Railroad stations in and near London, have commenced in the paint stores. In a very large fire in an oil warehouse, a quantity of oil was spilt the day before and wiped up, the wipings being thrown aside. This was believed to have been the cause of the fire, but direct proof could not be obtained. Dust bins also very often cause serious accidents. In one instance, £30,000 to £40,000 were lost, apparently from hot ashes being thrown into a dust bin.

These accidents may in a great measure be avoided by constant care and attention to cleanliness, and where paints and oils are necessary, by keeping them in some place outside the principal buildings. Dust bins should as much as possible be placed in the open air, and where that cannot be done, they should be emptied once a day. No collections of rubbish or lumber of any sort should be allowed to be made in any building of value.

Mr. Wyatt Papworth, architect, has published some very interesting notes on spontaneous ignition, giving several well-authenticated instances.*

Incendiarism may be divided into three sorts—malicious, fraudulent, and monamaniac. Of the former there has been very little in London for many years. The second, however, is rather prevalent. The insurance offices, which are the victims, protect themselves as well as they can, but an inquest on each fire is the true mode of lessening the evil. This is much more the interest of the public than at first seems to be the case. In several instances where the criminals were brought to punishment by Mr. Payne's inquests, people were asleep in the upper parts of the houses set fire to, and in one case there were as many as 12 or 15 persons. This, however, is seldom stated in the indictment, as if it is, the punishment is still death by the law, and it is supposed that a conviction is more easily obtained by the capital charge being waived. Monomania is a rare cause of incendiarism, but still several well certified cases have occurred in which no possible motive could be given. In one instance a youth of 15 set fire to his father's premises seven times within a few hours. In another, a young female on a visit, set fire to her friend's furniture, &c., ten or eleven times in the course of one or two days. In neither case could anything like disagreement or harshness be elicited, but the reverse. In other instances it has been strongly suspected that this disease was the cause of repeated fires, but there was no positive proof. In all these cases, known or suspected, the parties were generally from 14 to 20 years of age.

The best means of arresting fires is a very wide question, as the only limit to the means is the expense. Different nations have different ways of doing the same thing. On the continent generally, the whole is managed by government, and the firemen are placed under martial law, the inhabitants being compelled to work the engines. In London, the principal means of arresting fires is a voluntary association of the insurance companies, without legal authority of any sort, the legal protection by parish engines being, with a few praiseworthy exceptions, a dead letter.

In Liverpool, Manchester, and other cities, the extinction of fires by the pressure of water only, without the use of fire-engines, is very much practised. The advantages of this system are very great; but, to enable us to follow this system, the whole water supply of London would require to be remodelled.

In America, the firemen are generally volunteers, enrolled by the local governments. They are exempt from other duties, or are entitled to privileges, which appears to satisfy them, as the situation of fireman is eagerly sought in most of the American cities.

Which is the best of these different modes it is difficult to say; perhaps each is best suited for the place where it exists.

On the first discovery of a fire, it is of the utmost consequence to shut, and keep shut, all doors, windows, or other openings. It may often be observed, after a house has been on fire, that one floor is comparatively untouched, while those above and below are nearly burned out. This arises from the doors on that particular floor having been shut, and the draught directed elsewhere. If the fire appears at all serious, and there are fire-engines at a reasonable distance, it is best to await their arrival, as many buildings have been lost from opening the doors, and attempting to extinguish fires with inadequate means. If no engines are within reach, it is well to keep a hand-pump. If that is not to be had, the next best thing is to collect as many buckets outside the room on fire as can be obtained, keeping the door shut; then creep into the room on the hands and knees (if the heat and smoke are considerable), and throw the water as nearly in the direction of the fire as possible, keeping the door shut while more water is being collected. The police of the metropolis understand shutting up fires so well, that they have

* C. and E. Layton, 150, Fleet-street.

in many instances kept fires two or three miles distant from the engine stations shut up till the firemen arrived in time to extinguish them.

The description of fire-engines found to answer best in the metropolis are those with 7-inch barrels and 8-inch stroke, throwing, at the ordinary rate of working, about 90 gallons of water per minute. If a larger engine is thought desirable, two of these can be easily joined together in one stream, giving 180 gallons per minute. This size is preferred, because the weight, with hose, implements, firemen, and driver, is about 30 cwt., which is as much as two fast horses can manage for a distance under six miles. It is not often that the engines are required to travel further than this; when they are, four horses are used.

For some years past, a hand-pump has been carried with each engine. They have been found of the greatest service in keeping doors, windows, &c., cool. They throw from six to eight gallons per minute, to a height of from thirty to forty feet, and can be used in any position. The idea of the hand-pumps was taken from the old-fashioned squirt, or "hand-engine."

The Committee for managing the London Fire-engine Establishment have lately turned their attention to steam-floating fire-engines. The first trial was to alter one of the floats previously worked by manual labour. This was found to answer so well, giving 700 gallons of water per minute (ordinary rate of working), under a pressure of 70 or 80 lbs. on the square inch, that another was constructed capable of throwing 1,400 gallons per minute, and of moving at the rate of eight miles per hour, propelled by the reaction of two jets of 10-inch diameter each, driven by one of Mr. Appold's pumps.

The firemen are drilled first daily, and then two or three times a week, for some months; and this, with an average of three calls a day, soon makes them acquainted with the routine of their business; but it takes years of constant work to make a thoroughly good fireman.

The main rule to be observed is to get as near the fire, with the branch * INSIDE the building, as possible, so that *the water may strike the burning materials.* If this cannot be done, the probability is that the building which takes fire will be lost. This is not so dangerous an operation as it appears (unless the building is supported on cast-iron, of which more hereafter), as, if the building is of the ordinary strength, the fire requires to burn some time before the building is so weakened as to give way. The firemen require some practice to be convinced of the advantage of this proceeding; not that there is any trouble in pressing them forward, the difficulty rather being to keep them back; but it is much pleasanter to show off the power of their engines outside, than to proceed, perhaps on their hands and knees, amid smoke, heat, and a deluge of water, no one being able to see or value their exertions excep their own officers.

The firemen in London being constantly employed on weekly wages, give their whole time to their employers, and are much more under command than where men are only occasionally employed. The wages and treatment being liberal, although the discipline is severe, there are generally a considerable number of candidates for each vacancy. Thus good men are obtained, seamen being preferred, as they are taught to obey orders, and the night and day watches, and the uncertainty of the occupation, are more similar to their former habits than to those of other men of the same rank in life. The large number of fires, is, however, the principal cause of any advantage the London firemen may possess over those of smaller places, and it is hardly fair to compare firemen who have only an opportunity of attending one or two fires in a week to those who attend nearly three fires a day.

The supply of water is the most vital part of any exertions towards extinguishing fire. Where the pressure is sufficient, and the mains large enough, by far the most economical mode of using the water is to attach the hose directly to the mains. In London, however, that can rarely be done, for several reasons. The greatest number of plugs are on the service pipes, that is, the pipes for supplying water for domestic and other purposes, which are only open a short time every day. If the cisterns are nearly empty, the pressure cannot be obtained till they are filled. Then, again, the plugs being some distance apart, it is difficult to obtain a sufficient number of jets. But when the plugs are full open $1\frac{3}{4}$ diameter, a sufficient quantity of water is obtained from each to supply three engines, each of which will give a jet equal to the plug if confined to one jet. The pressure also in the mains in London seldom exceeds 120ft. at the utmost. For these reasons the pressure from the mains is seldom used till the fire is checked, when the ruins are cooled by the "dummies," as the jets from the mains are named by the firemen.

London is, upon the whole (except in the warehouse districts), fairly supplied with water for the average description of fires, that is, where not more than five or six engines are required. When, however, it is necessary to work ten or twelve engines, there is very often a deficiency. In New Cannon-street, where some of the largest warehouses have lately been built, except at the crossings of the old streets, there is only a $4\frac{1}{2}$-inch service pipe. In other warehouse districts the supply is very limited indeed, although it is amongst the warehouses that the largest fires take place.

The water companies are generally willing to give any quantity of water, but they object to lay down large mains without any prospect of remuneration. The warehouse keepers decline to be at the expense of laying the pipes, and there the matter seems to rest. In most other places of importance, the water is under the management of the civic authorities, and they, of course, endeavour to obtain a good supply of water at fires in warehouse as as well as in other districts.

What is "Fireproof Construction?" is a question which has given rise to a great deal of discussion, simply, as it appears to me, because the size of the buildings and the quantity and description of the contents have not always been taken into account. That which may be perfectly fireproof in a dwelling house, may be the weakest in a large warehouse. Suppose an average sized dwelling house $20 \times 40 \times 50 = 40{,}000$ cubic feet, built with brick partitions, stone or slate stairs, wrought iron joists filled in with concrete, and the whole well plastered. Such a house will be practically fireproof, because there is no probability, that the furniture and flooring in any one room would make fire enough to communicate to another. But suppose a warehouse equal to twenty such houses, with floors completely open, supported by cast iron pillars, and each floor communicating with the others by open staircases and wells; suppose, further, that it is half filled with combustible goods, and perhaps the walls and ceilings lined with timber. Now, if a fire takes place below, the moment it bursts through the upper windows or skylights, the whole place becomes an immense blast furnace; the iron is melted, and in a comparatively short time the building is in ruins, and it may be the half of the neighbourhood destroyed. The real fireproof construction for such buildings is groined brick arches, supported on brick pillars only. This mode of building, however, involves so much expence, and occupies so much space, that it cannot be used with advantage. The next best plan is to build the warehouses in compartments of moderate size, divided by party walls and double wrought iron doors, so that if one of these compartments takes fire, there may be a reasonable prospect of confining the fire to that compartment only. Again, cast iron gives way from so many different causes, that it is impossible to calculate when it will give way. The castings may have flaws in them; or they may be too weak for the weight they have to support, being sometimes within 10 per cent.,

* The branch is the metal piece screwed on to the end of the hose, carrying at its termination the jet.

or less of the breaking weight. The expansion of the girders may thrust out the side walls. For instance, in a warehouse 120 feet X 75 feet X 80 feet, there are three continous rows of girders on each floor, with butt joints; the expansion in this case may be 12 inches. The tie rods to take the strain of the flat arches must expand and become useless, and the whole of the lateral strain be thrown on the girders and side walls, perhaps weak enough already. Again, throwing cold water on the heated iron may cause an immediate fracture. For these and similar reasons, the firemen are not permitted to go into warehouses supported by iron, *when once fairly on fire.*

To show the effect of fire on iron a few specimens are laid on the table, viz. :—

Nos. 1, 2, and 3.—Three specimens of iron from the engineers' workshops of Messrs. J. Scott Russell and Co., Millwall, 10th September, 1853.

No. 6.—Specimen of slate from the same place.

Nos. 7, 8, 9, and 10.—Specimens of iron from a fire in Covent Garden Theatre, 5th March, 1856.

Nos. 11 and 12.—Specimens of slate from the same place.

No. 13.—Brick and slate from the same place.

Nos. 14 and 15.—Specimens of iron from the fire in the saw mills of J. Scott Russell and Co., Millwall, 12th March, 1856.

The effect of fire on cast iron, as stated by Mr. Fairbairn, F.R.S., of Manchester (7th Report of the British Association, 1837, vol. 6, p. 409), is, that the loss of strength in cold blast cast iron, in a variation of temperature of from 26° to 190° = 164° Fahr., is 10 per cent., and in hot blast, at a variation of from 21° to 169° Fahr., is 15 per cent. Now if the loss of strength advances in any thing like this ratio, the iron will be totally useless as a support long before the fusing point is attained.

It is sincerely to be hoped that the clause in the new Building Act, restricting the size of warehouses, may be more successful than its predecessor, for it is not only property that is at stake, but human life. In many of these "Manchester warehouses" there are 50, or 100 and upwards of warehousemen and servants sleeping in the upper floors, whose escape in case of fire would be very doubtful, to say the least of it.

Covering timber with sheet iron is very often resorted to as a protection against fire; but Dr. Faraday, Professor Brande, Dr. D. B. Reid, and Mr. W. Tite, M.P., are of opinion that it may be useful against a sudden burst of flame, but that it is worse than useless against a continued heat. Even cast-iron, one inch thick, laid on tiles and cement three inches thick, has allowed fire to pass through both, to the boarding and joisting below, merely from the fire in an open fireplace being taken off and laid on the hearth. This arises from iron being so good a conductor that, when heat is applied to it, it becomes in a very short time nearly as hot on the one side as the other. If the smoke escapes up a chimney, or in any other way, there may be a serious amount of fire before it is noticed.

The statistics of fires are much too voluminous for such a paper as this, especially as they have been repeatedly printed already. Mr. Baddeley has, for upwards of twenty-three years, sent the annual list of fires to the *Mechanics' Magazine*, and his mode of treating the subject is very interesting. In the *Quarterly Review* for December, 1854, there is a very elaborate statement of the whole subject, condensing the Reports of Fires in London for twenty-one years.

I may mention, in conclusion, that fires in London have been doubled since the commencement of the Fire Brigade in 1833; and not only are the "calls" doubled, but the fires at which it is necessary to put engines to work have increased in a much greater ratio, being nearly three times the number they were twenty-three years ago.

Many reasons have been given for the increase in the number, as well as in the serious damage caused by fires of late years. It appears to me that the many improved modes of heating, and the general use of gas, render spontaneous ignition much more common than formerly, and, when premises do take fire, cause the fire to proceed much more rapidly. In 1833, of the number of premises which took fire, barely 21 per cent. (20.9) used gas; while, in 1855, gas was used in upwards of 67 per cent. of the buildings which took fire.

DISCUSSION.

Mr. SIBLEY, in a note to the Secretary, after regretting his inability to be present at the discussion, says, "I beg to adduce one fertile source of fires, that is, the fixing of the boiler furnaces of steam-engines, and other furnaces and close fires, against party walls, in which wood plates and bond timber are not unfrequently found. Under the Act of 1844, a clear space of six inches was made imperative, between the setting of the furnace and the party wall. Under the present Act they are subject to *no* restric tion or regulation whatever. The only difficulty to be overcome is, the wedded habit of building to this mode, and the trouble that anything apparently new involves. The disuse of bond timber and plates altogether; the introduction of iron hoop bond, and stone templates in their place; the building of cross walls, in lieu of hollow wood partitions, would tend much to diminish the hazard of fire. Wrought iron brestsummer girders should also take the place of wood brestsummers; when these are burnt through, it is manifest that the whole superincumbent mass of brickwork has nothing for its support."

Mr. CHADWICK, C.B., said that the Society would, no doubt, appreciate highly the precautionary admonitions, as well as the suggestions of structural arrangements for the prevention of calamities, communicated that night from a gentleman to whom was due the example of a centralised and well managed establishment, which contrasted with the numerous separate establishments of the parochial, or so called local self-governments. He (Mr. Chadwick) had had occasion to examine the administrative arrangements for the repression of fires in the metropolis, as well as in other places. He had found that there were in the metropolis 150 separate parochial fire-engines and stations, and only 17 engines or land stations of the Fire Brigade; yet, notwithstanding that the relative proximity of the separate locally managed engines, as compared with those of the central establishment, might be stated to be as the relative numbers, or almost nine to one, yet in two fires out of every three, the engines of the centralised and systematised establishment were the first on the spot, and the relative efficiency of their action when on the spot need not be described. But, quick as they were, or could be, he yet found them to be deplorably too slow. Mr. Braidwood had admitted in his testimony that in the great majority of instances, that is, when the fire had got hold of the premises, it was a waste of power to attempt to save the premises where the fire broke out, and that its best application was in preventing its extension to the premises contiguous. He (Mr. Chadwick) had got the police to note the time which elapsed between the first alarm of fires and the arrival of the engines; and the return upon the first group of observations was 36 minutes. It appeared that the engines traversed the streets, allowing for obstacles, at a rate of 10 miles an hour. Information would be conveyed to the stations of the brigade at a rate of five miles an hour. In the case of the occurrence of a fire within a mile of the station, the information would be conveyed in twelve minutes; the horses would be put to and the engine got out in about five minutes on the average; it traversed the distance and arrived at the fire in about six minutes more; the water had to be got and got into the engine, which would occupy about five minutes; making about twenty-eight minutes; or, for a half mile distance, an average of not less than 20 minutes, which must occur under the most favourable circumstances. This arrangement he could not but consider as fatally too

slow. A pail-full of water might suffice within the first minute, after ignition; in the second minute more than a ton weight would be required. In respect to fire-escapes, Mr. Braidwood himself had testified that they would seldom be of use unless they were on the spot within five minutes after the alarm was given. On an impartial consideration of the facts, he was confident that practical concurrence would eventually be given to the conclusion at which he had arrived, that the principle of all future arrangements for the repression of fires must be a constant supply of water kept at high pressure night as well as day, and the direct application of it from the mains before the door by means of a hose and jet. By that arrangement he had proved, that a power equivalent to three or four of the best engines might be kept constantly before each door ready for application within two minutes. Having been consulted on the subject by Mr. Edward Rushton, the late benevolent stipendiary magistrate of Liverpool, and having learned of the corroborative example of the use of water direct from the mains, first for the cleansing of the streets and houses at Philadelphia, and then for the extinction of fires, he (Mr. Chadwick) gained his advocacy of the plan at Liverpool. When, upon his advice, Mr. Rushton proposed it to a Committee of the House of Commons, the proposal was received with laughter. The very serious effect of the conflagrations in the warehousing interests at last occasioned it to prevail in Liverpool, and, as had been stated that night, with such an effect in increased safety, as was shown in the insurance charges. In a communication to him, Mr. Newlands, the borough surveyor of Liverpool, had stated the new practice: "The mains from this reservoir under high pressure, are available over the whole of the town." "On arriving at a fire the stand pipe or pipes are put down, and the hose run off the reels in an instant, and, it may be, a dozen jets are playing, and the flames nearly extinguished before the engines have left the yard." "Serious fires are now seldom heard of, for before the flames can gain head the jets can generally be played upon them, and this is the only time that there is a chance of subduing them." The mechanical or engineering objections made to the application of the like arrangements to the metropolis, were wholly illusory. On a competent and impartial examination it would be found, that what had been done in some cities might be done with economy in the metropolis and all others. Mr. Baddeley, who had attended all the principal fires which had occurred in the metropolis during the last thirty years, and who had given anxious attention to the subject of the water supply, had testified that by arrangements which should ensure the application of water to fires within even five minutes after their commencement, the progress of two-thirds of them would be effectually arrested. Mr. William Lindley, the engineer who had rebuilt that portion of the city of Hamburgh which had been burned down, and who had stated that, in that rebuilding, he had been guided in his arrangements for house and main drainage and water supply by the principles laid down in his (Mr. Chadwick's) sanitary report, had given in respect to the arrangements of the water supply, the following testimony, which was complete and conclusive in itself:—Mr. Lindley was asked—

"Is the jet used at Hamburgh for watering the streets? Yes; and the charge has been 1d. per foot of frontage per annum.

"What provision is made with the new system of works which you have laid down for the prevention of fires? The mains are large—from 6 to 20 inches diameter—constantly charged at high pressure; being supplied from the one extremity by two Cornish engines, and at the other level from a high summit reservoir kept constantly filled. Throughout the whole length of the pipeage are placed, at intervals of 40 yards, fire-plugs, of 3 inches diameter in the clear.

"How soon can a jet be supplied for the extinction of fires? In two minutes. The men who get paid by old custom for the use of their engines will come, though they are not wanted, but the power of eight engines may be anywhere applied, as quickly as the hose can be screwed on, and introduced *inside* the house where the fire is.

"Have there been fires in buildings in Hamburgh in the portion of the town rebuilt? Yes; repeatedly. They have all, however, been put out at once. If they had had to wait the usual time for engines and water, say twenty minutes or half an hour, these might all have led to extensive conflagrations.

"What has been the effect on insurance? The effect of the rapid extinction of fires has brought to light to the citizens of Hamburgh, the fact that the greater proportion of their fires are the work of incendiaries, for the sake of insurance money. A person is absent; smoke is seen to exude; the alarm of fire is given, and the door is forced open, the jet applied, and the fire extinguished immediately. Case after case has occurred where, upon the fire being extinguished, the arrangements of incendiaries for the spread of the fire are found and made manifest. Several of this class of incendiaries, for the insurance money, are now in prison. The saving of money alone, by the prevention of fires, would be worth the whole expense of the like arrangements in London, where it is well known that similar practises prevail extensively."

He (Mr. Chadwick) had obtained, through Mr. Braidwood, the statistical facts, that whilst, in general, of the parcels of property or tenements in the metropolis only about one-half was insured, it so happened that of the properties burned more than two-thirds were insured. The inference from this bare statistical fact of the greater danger of property after insurance, which was attributable in part to the weakness of natural motives to precaution, as well as temptations to crime, had been corroborated by the regular inquiries instituted into the causes of fires by Mr. Payne, the coroner, which the Corporation, with wasteful and characteristic parsimony, had stopped. But the men of the Fire Brigade were well aware, from circumstances which, in the absence of a system of public prosecution (and which left public companies open to the imputation of prosecuting merely for greed), that the extent of incendiarism was far greater than was displayed even by Mr. Payne's inquiries, great as that was. So great, indeed, was the proportion, that the director of one company, on hearing of a fire, and before knowing the circumstances, was accustomed to exclaim, "More incendiarism." The present state of things—the combined prevalence of defective legislative and administrative as well as of engineering arrangements, in the face of proved available means of protection—the weakening of the unconscious action of natural interests in precaution by unguarded full insurance, in contravention of the established principles of insurance—the temptation to the commission of crime by the absence of proper means for its detection and prosecution—the daily occurrence of fires in the metropolis, the number of horrible deaths from them, as well as the loss of property which they occasioned—the apparent apathy with which such calamities were regarded, and the rapidity with which they were forgotten—were deeply to be lamented, and would hereafter be referred to as evidence of a very low social condition, and of defective administrative capacity and organisation.

Mr. JOHN BRAITHWAITE could not say to whom the greater compliment was due—whether to the Council of the Society, in having requested Mr. Braidwood to indulge the Society with the valuable paper that had been read; or whether to Mr. Braidwood himself, for the able manner in which he had put together so many excellent ideas, and so much that would not end, he was certain, upon that night. It was the most valuable subject, perhaps, with the exception of one, that had ever been broached in the Society; and it was one which he had no doubt would be thoroughly sifted before the discussion terminated within those walls. The subject before them was the prevention and the arresting of fires. He arrogated a little to himself, as being what was termed one of the earliest and oldest fire-eaters; for that was the designation, not within the last few years, but something more than a quarter of a century ago; and it was a matter of great surprise to him to know that the means (his steam

fire-engine) which were then practically and successfully adopted and approved by the public—by the many thousands who witnessed the experiments then tried—that in all these matters, which were carried out at his individual expense, that he was permitted to incur such an enormous outlay of money for the benefit of the community, without having received a sixpence in the shape of reward, directly or indirectly, from any one, excepting some of his servants, who, upon one occasion, were presented with a sovereign from the gentleman who sat on the left of the chairman (Mr. Braidwood), for some particular exertion at one of the fires, at which the particular means he (Mr. Braithwaite) adopted was employed. Mr. Chadwick, who was always clever, with his usual tact, in the observations he made, had told them that if they got a little water, and applied it to the fire at once, they need not give themselves the trouble to look for a great quantity of water at the last. In the early period of the building of Drury-lane Theatre, every possible means was adopted to prevent fire occurring, under his father's directions, in conjunction with Colonel Congreve and the late Mr. Whitbread. It was carried out to a perfection that was almost unheard-of, or thought to be practicable. There was not a spot in any part of that theatre but that at one moment's notice they could control any chamber, however remote or however near, by—not a deluge of water, but sufficient water at a particular moment to arrest the progress of the flames. The greatest advantages experienced, however, were from two small garden engines, that cost but £15 each, one in each fly; so that the instant there was anything like conflagration, the small branch, with a fan top to spread the water, was applied, and the fire was extinguished even whilst the performances were going on. Many times had the theatre been on fire under such circumstances, and many times successfully extinguished, with only a few gallons of water. About that period, Mr. Salmon, one of the agents of the Duke of Bedford, introduced the portable or chamber fire-engine. He (Mr. Braithwaite) was, at the time to which he alluded, an extensive manufacturer, and constructed hundreds of these little engines, at the moderate cost of £3 each. Great numbers of people availed themselves of these little portable engines, which held some four gallons of water. They were placed in the hall of their dwellings, and on the bedroom landings; and by them, he believed, many hundreds of houses had been saved from destruction by fire. Mr. Braidwood happily looked upon his fellow-creatures with the same cast-iron nerves that he possessed himself, when he told them to close the doors—to go for water—to creep cautiously into the apartment on fire—and apply the water to the particular portion on fire. Mr. Braidwood could do all that—he had seen him do it—but how many among those present would like to try the experiment. The little water was everything, if they could lay their hands upon it, even in a pint pot. In the great fire which occurred at Barclay's Brewery, all except the malt-lofts was burnt down; and he believed that he (Mr. Braithwaite) was instrumental in saving some £60,000 worth of malt. The beams had caught fire on one side of the malt-lofts; he went across one of the beams with two pint pots, and carrying a gallon of water under his arm; and by applying it in the way recommended in the paper, he extinguished the fire in the beams, and the malt was saved. He had spoken of the *little* water; he would now say a word or two with respect to the *larger* quantity. He was glad to find that in 1856 there was a little more moral courage displayed than there was in the year 1830, and from that to 1835. When he saw Mr. Braidwood there, the chief of the Fire Brigade—and, although the phrase was hackneyed, he would say, "the right man in the right place,"—when he found he came boldly forward, in spite of those who were his employers, to give information how, to the best of his judgment, as far as he might venture, to put fires out, he repeated, he was astonished, but no more astonished than delighted. He (Mr. Braithwaite) believed it was not to the interest of fire insurance companies to put out fires! He had evidence beyond any doubt on this point, and the remark which Mr. Braidwood made about legislative interference, led him to think that from that hour the legislature would look more into these matters than they had done before—the only safeguard between the public and the insurance offices—for he must tell them that in 1830, under the special request and encouragement of the insurance offices, he constructed that which would not prevent fires, but would and did extinguish them most effectually, and that was the Steam Fire engine. He (Mr. Braithwaite) first constructed an engine of 10-horse power, and he was told by the authorities it was too large, and that he would pump the Thames dry. He then constructed one more portable, of 5-horse power, with which he succeeded, without a single failure, at the numerous fires he attended. The first great exhibition of the powers of that invaluable machine, was when he had the honour of the company of the late Duke of Wellington and Sir Robert Peel, who remained with him witnessing its powers at the Argyll Rooms, when, but for that engine, he could not say but that the whole of Regent-street might have been destroyed. The rdinary fire engines were one and all frozen up on that occasion, and the steam fire engine alone was capable of being worked. The fire was extinguished, and he received congratulations not only from the public, but from the insurance companies, upon the success of the engine. He afterwards was summoned to attend several meetings of the Committee of the several Fire Insurance Companies, and after numerous attendances and promises of patronage, he was then told a secret by Mr. Jones, of the Phœnix Office—"why give Mr. Braithwaite so much trouble, when he knows it is not to our interest to have such a machine as his going about; as, if the public were aware that the Insurance Companies had such powerful means of extinguishing fires, no one would come and insure." Nothing then seemed to be wanted in the opinion of Mr. Braidwood but two classes of engines, the ordinary engines and the hand-engines. He must get more of them, and he must not put down the parish engines, and if the parishes did not provide and keep their engines in an efficient state, the legislature must interfere, and they must be brought into more extended use. He (Mr. Braithwaite) said, in 1835, "if you do not want those large engines upon land you will want them at least upon the river." He made drawings and estimates and sent them into the Committee, and after two or three weeks' consideration, he received a letter from Mr. Braidwood, stating that they had not time to take the thing into consideration at that moment, but as soon as they had, they would avail themselves of his valuable services. Now, they were told, attention had been directed to steam for a floating engine. He would ask, if the object was to put out fires, why did they not begin in 1835 as well as in 1855; therefore, he said, he was pleased in 1856 to see Mr. Braidwood come there and give them information which he (Mr. Braithwaite) felt certain he would not have communicated in 1835. They were now upon the eve of having a high-service supply of water, so that there would not be a single room in any house in which they could not obtain a continuous supply of water at all times, when by the application of a small cock and a gutta-percha pipe within the dwellings, fire engines from the outside might, perhaps, be dispensed with. There was now an Act of Parliament, which he had the honour of assisting to conduct through the House—the Metropolitan Water Act—by which water companies are obliged to supply the best filtered water under pressure from the top to the bottom of houses at any and all times. That, he thought, would be one means of averting conflagrations. The numerous fires that occurred were not matter of surprise to him, for which two principal causes might be assigned:—In the first place, the number of houses was doubled, the population was doubled, and the use of gas had multiplied in a ten thousand-fold ratio. Therefore, the number of fires

in the metropolis was not surprising; and if Mr. Braidwood would impress upon those for whom he acted that it was necessary to give him the great power he would have from the application of steam to engines upon land, the same as had been done to those on the water, he could, as far as he was concerned, accomplish in the present day what was effected formerly at the Argyll Rooms, Lyceum Theatre, Barclay's Brewery, and other conflagrations.

Mr. HAWES regretted that the discussion upon the interesting paper which had just been read had been interrupted by the charge which the last speaker had brought against the insurance offices of this metropolis. Were no other evidence at hand to disprove his assertions, their inconsistency with his previous statements would be sufficient to do so, for was it not clear that to the combined action of the insurance offices we owed the efficiency of the Fire Brigade, and the appointment of Mr. Braidwood himself, and through him the collection of the information by which the mischievous action of fires was materially lessened. But besides this, let us look at these statements as a matter of business. How did the offices make their profits but by the premiums they received without any claims being made. Surely it would not be easy to make a profit if, after receiving a small premium, they encouraged the destruction of the property from whence their income was derived, and had, besides, to find the money to rebuild the property destroyed. To leave this part of the subject, however, he should like to inquire of Mr. Braidwood how he explained his statement that hot-water pipes, by me chemical action, when placed near wood work, caused fire. Indeed, he was puzzled by the paper to know which was the safest mode of heating a house. Gas, it was said, was dangerous, so were open fires and close fires, and hot water and steam. He hoped, therefore, we should have something more as to which was the best and safest mode of heating our houses.

Mr. MARRABLE said his principal object in rising was to offer a few observations in refutation of the remarks made by Mr. Braithwaite, to the effect that the insurance offices rather encouraged fires, and that Mr. Braidwood was under control, so that he did not say all he could as to the readiest means of preventing and extinguishing fires. Now, so far from this being the case, Mr. Braidwood, who must be looked upon as the representative of the fire offices, was deserving of the greatest credit for the anxiety he had shown, and the intelligence with which he had brought his great practical knowledge to bear upon the subject whenever new bills had been before Parliament for regulating the construction of buildings in the metropolis. In the bill of 1844, and the present Building Act of 1855, several clauses had been introduced, he believed at the suggestion of Mr. Braidwood, for the prevention of fire, as much as possible, by disallowing the introduction of bond timber and wood bricks, and other regulations, and for arresting its progress by sub-dividing buildings by cross or party walls, when they exceeded, in cubical contents, a certain number of feet. He (Mr. Marrable) was not prepared to go quite as far as Mr. Braidwood in the regulations as to the distances at which it was now the law that all pipes for warming by hot water or steam should be fixed from any wood work, viz., three inches. When high-pressure pipes were used, the precaution was wise and necessary; but he did not think there was any occasion for such a restriction when pipes for hot water at a low-pressure only were used. He feared that such a rule might be found very difficult to carry out in all cases. He also dissented from the supposition that "a chemical action took place between heated iron and wood." He believed that the only action was, that the constant heat at last reduced the wood to a state resembling touch-wood, which was ready to take fire on the slightest accident. With regard to the difficulty of enforcing the rules respecting the laying hearths free of all timber work, it should be mentioned that the builders were bound to give notice to the district surveyors, whose business it was to enforce the rules of the act. This they were not generally backward in doing, although it was possible that some builders might manage to cover up and conceal irregular construction during the absence of the district surveyor. Moreover, there was always more or less difficulty in getting the magistrates to convict.

Mr. F. WHISHAW remarked, that when this subject was brought before the Institution of Civil Engineers, about four years ago, it was stated in the course of the discussion that as bulkheads were useful in preventing fires extending in ships, party walls should be adopted in large warehouses, so as to divide the space and confine the fire to the spot where it originated. That suggestion was approved of by Mr. Braidwood, and also by Professor Hoskyns, the official referee of the insurance companies. He was glad to find that Mr. Braidwood still held to that opinion, and it seemed to him that in any future Acts relating to building, clauses to that effect should be introduced. He knew a warehouse in Bermondsey with an unbroken area of wooden flooring of three quarters of an acre. There were also many large granaries which might be easily divided and fire prevented from extending. Mr. Braidwood seemed to think that the large buildings in the City had been constructed without reference to such precautions. He would mention that a very efficient mode of obtaining notice of a fire breaking out was furnished by the electro-magnetic alarum, which consisted of a simple tube of mercury connected with wires attached to the alarum apparatus and battery. Upon a fire breaking out the heat caused the expansion of the mercury, by which the circuit was completed, and the electric current was enabled to pass, setting the alarum in action. He confessed he was astonished that the steam fire-engine had not been introduced into London; he was at a loss to conceive why the insurance offices had not adopted that efficient mode of extinguishing conflagrations by which hundreds of tons of water might in a short time be thrown upon the burning mass.

Mr. CHARLES MAYHEW said, as he was surveyor to one of the oldest insurance companies, and a district surveyor, he could speak with some confidence on the subject brought forward by Mr. Braidwood. He begged, in the first instance, to reply to the observations made relative to the steam fire-engines. The reasons why they were not generally adopted on land was, that the large quantity of water which they could supply was not, in the generality of cases, required, inasmuch as water injudiciously applied, did, very often, more damage than the fire would if left to the judicious management of the Fire Brigade to extinguish, which was, in most cases, stopped in a way perfectly astonishing. He had now two damages in hand to make good—one to a large house in Park-lane, where the timbers of the roof caught fire through a defective flue belonging to the adjoining house. The timbers were in a blaze from one end of the roof to the other, yet the fire was extinguished by the Fire Brigade before it got through the greater portion of the slate and lead covering, and although the water had penetrated into the rooms below, yet it was not supplied in such superabundant quantities as to do any serious damage. The other instance was in Strutton Ground, Westminster, where the contents of the shop, which was filled with combustible matter, also the staircase and the two back rooms, were nearly consumed, and the two front rooms over the shop were left entire (the doors being shut), and the furniture was only slightly injured. This showed that a judicious and moderate application of water, by men who thoroughly understood the business, was far better than tons supplied by those who did not understand it. Another reason against the steam fire engine was, that it must continually have the steam kept up, otherwise it would take too long to bring it into use. As regarded the observation which had been made that fire offices did not care for fires being

extinguished, he could assure the meeting that such a remark was fallacious. He (Mr. Mayhew) not only spoke as an officer, but as a large proprietor, and he could safely assert that they would call Mr. Braidwood severely to account if he were to allow fires to go beyond their justifiable limits. He had great pleasure in testifying to the efficiency of the Fire Brigade and its admirable management, and there was no want of alacrity. It certainly might be more efficient if they had more funds. As regarded the structure of buildings, he was quite persuaded that unless the legislature would adopt strong measures, fires would continue as heretofore. Houses ought to be constructed on the French system, and not as they were built here, on purpose to burn. They were piled up as the wood was placed in a grate to light a fire. The floors were wood, the partitions were wood, the stairs were wood, so put together as to be all hollow, and so connected as to allow air drafts in every direction; and oftentimes the brick walls were what were called battened, allowing air vents behind the plastering. Thus the house was on fire from top to bottom before it was known by the inmates that a fire had broken out, and the doors and windows in the surrounding walls allowed the admission of air to feed the flames. It was difficult perhaps to construct any thing fire-proof, but still it could be approximated to; it might perhaps be more costly so to build, but what was cost compared with loss of life. Speculating builders, however, would never adopt this manner of building, unless compelled by an Act of Parliament. With regard to the construction of warehouses, he did not think that anything would be effectual unless they were entirely constructed of brick, which would occupy too much room and be exceedingly inconvenient. Therefore the only way was to confine them to a certain cubical content, as required by the present Act of Parliament. Another source of fires was using common flues for close fires; such flues were only enclosed by 4 inch brickwork, which was wholly inadequate. Another evil was using Welsh fire-lumps at the back of grates, which, if fixed close to the party wall (especially in old houses, wherein timbers where almost invariably inserted) very often set fire to the adjoining houses. He had recently met with a case of this kind. He would conclude his remarks by urging the necessity of attending to the admirable advice given by Mr. Braidwood in his paper, and by thanking him for his labours.

Mr. JOHN W. PAPWORTH,* F.R.I., B.A., would venture to reverse the order of the remarks made by Mr. Braidwood, so as to inquire, first, whether fire-proof buildings could be made; and found himself, with much pain, opposed in opinion—apparently, but perhaps not in fact—to the authorities named by the author of the paper just read. He put forward a contrary opinion to Mr. Braidwood's with some hesitation, because that gentleman had had the opportunity of seeing many cases of total destruction; but he was convinced that Mr. Braidwood laboured under the difficulty of condensing the materials for a large book into the limits of a paper like the present. He assumed that it would be agreed that what people called fire-proof materials were literally the least protections in a great fire. Thus, stone staircases were likely to crack at the wall, and fall, long before an equally solid wood staircase would be unsafe to the escaping occupier. Iron beams pulled the whole building down with them, whereas wooden beams, sadly charred, remained long after the engines had ceased working; and, in a great fire, even brick arches failed, and fell. He admitted that very thick arches would stand a great heat; but the little things which were now called brick arches were impotent before even a moderate fire. A friend was saying, last year, that he saw a brick-arched warehouse, belonging to his family at Liverpool, appear to melt down into the flames. Mr. Piper had observed that Yorkshire stone was exceedingly destructible by fire, and that, practically, it did not furnish a fire-proof floor; but this did not appear to be Mr. Tite's opinion. And Mr. C. H. Smith considered that concrete, properly made, would bear a very considerable degree of heat, perhaps more than Yorkshire stone. Mr. Barrett had stated that, supposing any intense degree of heat to be generated, before it would act injuriously on iron and concrete, it would, probably, quite destroy a brick arch, either by disintegration, or by the arch's own expansion. Mr. Braidwood seemed to think that the only fire-proof construction for large warehouses, where an intense degree of heat might be generated, was groined brick arching on brick piers. He (Mr. Papworth) accepted these discordant statements as evidence to one thing—viz., that none of them were fire-proof in the ordinary sense of the word; and gave great credit to Mr. Braidwood for the distinction drawn between ordinarily fire-proof, extraordinarily fire-proof, and incombustible premises. The public had certainly been misled by the scientific acceptation of common terms. Fire-proof did not mean incombustible, but only "not very likely to be totally destroyed by fire." Covering wood work with metal was allowed by the insurance offices to be a prevention to a certain extent, that is to say, if a current of air passed between the hearth and the metal that touched the wood. A stone was equally a prevention under such circumstances, but he had seen a case where the hearth touched the stone; both the hearth and the stone had cracked—merely cracked—and the floor below took fire, with no current of air between the plate or stone and the hearth. Such covering was not a certainty of prevention, and, therefore, a second shield interposed was not an extravagant precaution, but was, perhaps, the most real protection that could be given in a case where a stove must be placed upon a floor. Having gone so far, he must own that if faith was to be put in printed documents, in Acts of Parliament, in reports of experiments, in patents, and in sculptured memorials, it would seem that, in opposition to the authorities mentioned by Mr. Braidwood, wood covered with metal was as much fire-proof, as it was more economical than any mode at present put forward as a protection against fire. Mr. Papworth referred to an obelisk erected in 1776, on Putney-heath, by order of the corporation of London, to commemorate the satisfaction felt by committees of that body with experiments made in that year, and described in a pamphlet published in 1785, entitled "An account of the invention and use of fire-plates for the security of buildings and ships against fire." The author, Mr. David Hartley, was M.P. for Hull. A reprint, with additions, by his nephew, in 1834, stated that, "resistance to every possible degree of fire, such as in distiller's shops, or turpentine warehouses, may be accomplished by applying metal plates above and below the timbers, with dry sand or rubbish between them. In experiments repeatedly tried with this double application, the room was filled from the floor to the ceiling with faggots and pitch and tar. As to common dwelling-houses; when the single application of the plates was tried in the experimental house, where also air bricks were provided to the floors, the trials were continued from day to day to the same part of the ceiling and timbers of the house a great number of times after the plaster-work was burnt down and destroyed; but the timbers could never be set fire to, so as to burn of themselves, nor could the fire ever spread sideways: as long as the burning faggots were applied to the timbers, they were charred perhaps to the depth of an inch of their substance, but the plates over them acted as an unconquerable extinguisher, preventing them from taking fire and burning of themselves." Rolled copper plates were specified, as well as those of painted iron. Tinned or galvanised iron or zinc would be equally applicable. In 1774, the sum of £2,500 was voted to the inventor by Parliament; and, in 1777, the patent was extended for thirty-one years. If these statements were worth anything, it seemed extraordinary that the system

* It should be stated that Mr. Papworth's views are printed at greater length than the time at the disposal of the meeting permitted of their being spoken.—SEC. S. OF A.

should have died; and it might be desirable that the experiments should be repeated. He (Mr. Papworth) also wished to recall attention to the statements formerly made that timber and woodwork which had undergone Payne's anti-dry-rot process were uninflammable. He regretted that there was not in this country a body that would undertake the verification and comparison of such statements. By the late Building Act any metal or other pipe or funnel for conveying smoke, heated air, or steam, ought not to have been placed nearer than fourteen inches to any combustible material. But this had been constantly neglected; and in most cases, the district surveyor had never known that work of the sort was being done; consequently, he could not be blamed for accidents. By the present Act, pipes for hot water must be 3-inches, for heated air or steam must be 6-inches, and for smoke or other products of combustion must be 9-inches from any combustible material; and no ventilation opening might be nearer than 12-inches to any combustible substance. Both Acts gave a penalty of twenty pounds if the work, although correctly done, had been executed without notice given to the district surveyor; and the new Act added a penalty of twenty pounds a day after non-compliance in forty-eight hours with a notice from the district surveyor that he had discovered the fault. It remained to be seen how this portion of the new Act would succeed. Mr. Papworth believed that a long time would elapse before a sufficient number of convictions had been obtained to render the proprietors of premises more careful and more honest than they were under the old Acts, which, Mr. Braidwood observed, were frequently infringed, and by men of reputation. The new Act had provided against the future erection of such extensive buildings as Mr. Braidwood inveighed, very properly, against, under the name of Manchester or piece goods warehouses; and now no warehouse or other building wholly or in part for the purposes of trade or manufacture, was allowed to contain more than 216,000 cubic feet, which was quite large enough, for they would then be 100 feet by 40 feet by 50 feet, equal to five of the ordinary houses mentioned by Mr. Braidwood. It was remarkable that the people should risk their lives by passing every night in lodgings, or even in their own houses, with the knowledge that there was no means of escape in case of fire, except at the windows of the front, where ladders could be raised. Yet such were the persons who would calculate, upon the best grounds, how many people returned home late at night with half-closed eyes, tried perhaps three or four lucifers, blew out the light which they had ignited, and went carelessly to sleep. The new Act was intended to provide against part of this risk, by preventing any new house being erected as a lodging-house to contain more than 3,600 square feet in area, that is to say, 100 feet long by 36 feet wide, also equal to five of the ordinary houses mentioned. Mr. Braidwood had alluded to the fires which he had met with, caused by neglect or infractions of the Building Act. In justice to a much abused body of gentlemen, he must say, that architects, builders and proprietors, did very frequently, sometimes wilfully, sometimes ignorantly, sometimes carelessly, defraud the district surveyor of his fee, by not giving him notice that work was to be done. On the other hand, the district surveyor trusted a good deal to the character of the tradesman employed, as well as to the good faith of the architect, if there was one concerned; but neither the district surveyor nor the master builder considered themselves called upon to watch the action of the workmen, and it was here that the damage was done. Mr. Tite built a fire-proof Exchange with false windows in it; a bricklayer was engaged to build a flue, and made the wood frame of the sashes serve as one side of the flue which took fire. Mr. Smirke built a wall across the roof of Covent Garden Theatre; no one could tell who pulled it down or when it disappeared. In his own house the ventilating shaft of the cellars was turned into a fireplace, and in a neighbour's a fireplace was bricked up and made a packet. Such were the aids, if not the literal causes, of fires, for which the district surveyor was abused, whereas the blame rested on those who cheated him of his fees. He agreed with Mr. Braidwood as to the difficulty of maintaining the attention of masters and servants to the consideration of the subject. He thought servants and masters were almost equally blameable, but that enough had not been said as to the wilful carelessness of masters, who, as educated men, should be reaonable beings. For instance, it was well known that lime in sacks, if wetted, would set the sacks on fire, and such fires had occurred twice in the yards of houses where the masters should have known better than to allow the lime to be placed against sheds. Servants were equally concerned in the results of inattention to a light or a fire. Yet, although a fire had occurred at the next house to his own, he could not find that less inattention than usual was paid to his family advice. He believed that such inattention to fire on the part of servants as he constantly saw in the houses which he professionally entered, was the result of a belief in superior skill or wisdom of the offending party; and this was only, so far as he knew, to be cured by punishment; but the inattention frequently only exhibited itself by setting the house on fire. Mr. Braidwood's hope of preventing fires was by enlisting the active inspection of the masters; but, if his (Mr. Papworth's) view of the case was right, matters would remain just as they were. The attention of the Society might be called to a few points in gas-lighting which bore upon the subject. Too many burners were made with taps which opened both ways, and allowed a careless or nervous person to leave it open; whereas a tap made with a stop gave certainty, even to the most nervous person, that there could be no escape from that jet. The use of composition pipes in lengths, not exposed, was a source of explosion more frequently than a defective meter. The meter ought never to be *in* a building. Mr. Papworth had in his own house one which became full of little holes, as if pricked with a pin. Snakes, as the flexible tubes were called, were dangerous, as the pressure of the gas forced liquid caoutchouc out of the india-rubber tubes, which was, of course, equivalent to an escape of gas. Mr. Papworth had a gutta percha tube which took fire at the union with the lamp; but he was fortunately present while the burning gutta percha pipe was dropping on the floor. Gutta percha pipes, as sold for the purpose, did not withstand the usual pressure of gas. The bad setting of ranges and stoves was a fertile source of fire, and it was to be regretted that the new Building Act appeared to leave that point to the discretion of the surveyors of the insurance companies; also that it had not provided for the immediate division of the great buildings called by the owners themselves warehouses, which were so evidently built in evasion of the spirit and intention of the old Act. With regard to some observations made during the evening, the insurance companies would naturally feel complacent when a fire occurred, if not on property insured; the alarm produced an increased business to the offices. The companies divided large risks, both of life and fire, among themselves; they could not rejoice in each other's losses. He eulogised the manner in which the Brigade attended any fire, without stopping to ask if the building was insured; and adverted to the improbability that even when the high service water supply became the rule, the majority of houses already built and unsupplied would be furnished with it. He mentioned one case in which the bursting of a cistern on the high water service had sent 800 gallons of water down a house, destroying property by inundation to a greater extent than any fire that could have occurred there on the same day. He held that in most cases the sudden alarm would leave the inmates of a house, supplied with continual high service, as much in need of the services of the Brigade as they were at present. He bore testimony from his own experience to the rapid attendance of the Brigade at a fire next door to his own house, and remarking on the difficulty of disturb-

ing the inmates, showed that few of the audience would have been able to have applied usefully the means which a high service would allow. He admitted the rapidity with which in Hamburgh fires might be extinguished of late years; and he described the attendance of the police at every double crossing in Paris and some French cities, with power to break open doors in case of fire; a permission given not only to the police, but to any person suspecting fire in some of the German towns, which he understood was the case also at Hamburgh. This was not the law in England, at all events in London, as the police had refused him permission to break a pane of glass, to pour a pail of water on the commencement of what he considered a case of incendiarism. With regard to the opinion of some foreign jurists on the propriety of confiscating a portion of the amount insured, Mr. Papworth explained the difference between the applicability of such a law in countries where the tenant was also the owner in almost every case, and its injustice in London, as representing England, where scarcely any house was occupied by its owner, who therefore, if he did insure, would be exposed to a certain loss by a malicious or careless tenant. He also explained that it was owing to the foresight of landlords, and not to fraudulent fires, that two-thirds, as stated, of the house property burnt in London, were found to be insured, in favour of the landlord, by the tenant.

Mr. PHILIP PALMER was anxious to have followed Mr. Mayhew, (who was the surveyor to the fire office of which he was a director) in order to support his disclaimer of the fire offices being actuated by interested motives in the non-suppression of fires, an assertion which was disproved by the noble establishment of which Mr. Braidwood was so distinguished an officer. The way in which the remarks of Mr. Hawes and Mr. Marrable had been received by the meeting, showed that the attack on the fire offices was groundless. All who remembered the old system, while they admired the brilliant coats and badges of the firemen, must admit that the present system was far superior; perhaps from the occasional rivalry of the men in those times, who felt more interest in houses insured in their particular offices, the charge that had been made had arisen; there were no doubt many good men in those days, as there were good "Charlies" or watchmen before the new police force was introduced. The Fire Brigade was to the old system what the new police force was to the old watchmen. It must be borne in mind that the Fire Brigade was really a private establishment, being instituted by the fire offices for the protection of their insurers, although the public received as much benefit, and could, in return, only bestow their gratitude. Mr. Braidwood had alluded to the parochial system having become a dead letter, which was to be regretted, still it might be restored, and the parish engine rendered available, if not to put out a fire, to hold it in check until a larger force arrived. He would be glad to see the matter taken up by the new Metropolitan Board of Works, of which so many members were present that evening, though he did not know how far they could co-operate with the Brigade. It had been suggested that parishes might give their money, which reminded him that, some years ago, an application had been made to the parish of St. Martin's, from the Society for the Prevention of Life from Fire, for assistance, and the parish had voted ten guineas annually, an example which other parishes had followed. In such a way support might be given to the London Fire Brigade establishment. Mr. Palmer could not speak on the rendering buildings fire-proof. He was afraid that if buildings could be made so, then, indeed, fire offices would be useless. As a director, having only the interest of the contributors, the discontinuance of the fire offices could not affect him, but it might those zealous and active officers of the fire offices who he should be sorry to see thrown out of employment.

Mr. G. F. WILSON, F.R.S., said, Mr. Braidwood had given so many valuable suggestions, that it was difficult to add to them. There was, however, one mode of checking a fire to which he had not alluded, and which, in his (Mr. Wilson's) earlier experiences, he had found prove useful. Some of the largest fires had occurred in chemical manufactories, where coppers or other vessels containing combustible materials were set over fires in heated brickwork. In most of these factories there were steam boilers. If the simple precaution were taken of connecting a steam-pipe from the boiler to the flue round the copper, in case of a leak or other appearance of danger, on a cock being turned on, steam was admitted, which, immediately displacing the air from the flue, damped the fire. Mr. Braidwood had spoken of iron pipes being a common cause of fire. From inquiries he had lately made as to the breaking out of fires in manufactories, it would appear that clay pipes (!) were a still more frequent cause of fire. When brought in, with their contents only half extinguished, they set fire to the men's jackets, which, stowed away in corners, started a fire that might not be for some time discovered.

Mr. Hows, in allusion to the remarks of Mr. Braithwaite, said he was a holder of shares in one of the insurance companies, and to his surprise he had been told that evening it was to his interest to do something detrimental to the public good. He, however, trusted that was not the general opinion of the meeting. He had expected some more extended notice in the paper upon the subject of fire escapes—a matter in which he took a great interest. He (Mr. Hows) proceeded to state the difficulties which attended the introduction of a fire escape for the public safety in the parish in which he resided (St. Leonard, Shoreditch), and in the affairs of which he had been in the habit of taking an active part. The public auditor of the parish accounts had refused to allow the charges connected with the fire escape, as a matter which was unauthorised by the Poor Law Act, but, after some contest, fire escapes were provided. An objection had been taken that the present fire escapes were too cumbersome to be of service in courts and alleys; but he thought, amongst the scientific men now present, a machine adapted for those narrow localities might be designed; and he hoped it would have attention and be carried out.

The CHAIRMAN stated that the hour was arrived at which the meetings usually closed; but, as he was informed there were several other gentlemen present who were desirous of offering their remarks upon the subject, it was suggested that the discussion should be adjourned.

Mr. NICHOLAY said, noticing the hour, he was about to suggest an adjournment of the discussion. The subject was one in which he had always felt a deep interest, more particularly with regard to fire-proof buildings. That subject he ventured to say had not been taken up in the way he thought it ought to be; and he would put it to the meeting whether the whole subject was not of that importance to justify a resumption of the discussion on a future evening.

The meeting having unanimously pronounced in favour of adjourning the discussion,

The SECRETARY announced that it would be resumed on Friday evening week.

The SECRETARY further announced that the paper to be read on the evening of Wednesday next, the 14th instant, was "On Means available to the Metropolis and other places for the Supply of Water free from hardness and from organic impurity," by Professor Clark, M.D., of Marischal College and University, Aberdeen. On this evening John Simon, Esq., F.R.S., will preside.

The Secretary has received, since the meeting, the following remarks upon spontaneous combustion, from Mr. G. F. Ansell, who says, "Amongst the causes from which large fires resulted, Mr. Braidwood mentioned spontaneous

combustion, and although not a member of your Society, I was sorry to find that no one offered any point from which to discuss this subject. As I cannot (from a previous engagement) attend the adjourned discussion, I would beg to offer a few remarks, which, should they meet your views, may possibly interest some of your members.

"Some years since Professor Dobereiner discovered that spongy platinum absorbed and condensed within its particles large quantities of oxygen, and that if a stream of hydrogen, alcohol vapour, coal gas, and sundry hydrocarbons, were allowed to flow upon this spongy platinum, a combustion ensued, evolving a very considerable heat. I do not go into details, but allude to facts for the sake of illustration. It has since been discovered that other substances possess this remarkable property, and I would now offer to explain, as no one else did, that the fact of oil and sawdust exciting combustion, may be due to this property existing at the same time with the extended surface presented by the sawdust. I have found that new cod liver oil and sawdust will enter into active combustion in about 8 or 10 hours, if considerable quantities (*e. g.*, a bushel of sawdust with as much oil as it will take up) be used. If for a moment you reflect upon the oxidation of alcohol in the manufacture of vinegar, as now practised by the agency of twigs, and the heat resulting, you will hardly be surprised at the heat under other circumstances being far greater. A curious case of spontaneous combustion occurred a few weeks since, and which certainly is not marvellous to chemists, but is astounding to those most interested, and which, perhaps, is new to yourself. A mass of iron filings and turnings had been allowed to accumulate at a large factory in this neighbourhood, and day by day were sprinkled with water in the process of laying the dust, previously to sweeping the floor. One night, after all the men had left, a fire broke out, which was soon arrested, but was most clearly traced to the spontaneous combustion of the iron turnings. It is known to every one that iron decomposes water, combining with its oxygen and liberating its hydrogen, and in this case I think that the grease generally attendant upon iron turnings was oxydised at the expense of oxygen condensed by the finely-divided metal, and so lent its aid in raising the temperature; and iron once heated burns with as much activity as tinder or old rags; but long before the heat reached this point the wood in the neighbourhood would have ignited. In your discussions it is much to be regretted that fire insurance companies cannot be left to themselves, while matter of importance to your members is discussed; but this cannot be while men who know very little make long speeches."

PARLIAMENTARY BLUE BOOKS.

In the *Journal* for the 7th of December, 1855, it was stated that Professor Leone Levi had issued the prospectus of a work under the title of "Annals of British Legislation, &c.," which he proposed to publish periodically, in parts, if a sufficient number of subscribers could be obtained. The Institutions will be glad to learn that the First Part of this work has just appeared.* A copy, as a specimen, has been sent to each Institution in Union.

Home Correspondence.

TEST OF STEEL MANUFACTURES.

Busby, near Glasgow, May 5th, 1856.

SIR,—As no popular practical steel tests are forthcoming in answer to Mr. Wilson's challenge, perhaps the following suggestions, properly carried out, may fulfil the conditions required, not only in reference to the manufacture of steel articles, but to the manufacturing of steel.

All workers in steel have sufficiently ready methods of testing its quality for the purposes required, but, as Mr. Wilson observes, "none are popular," and are only known to the initiated.

Aquafortis is well-known for its action on steel, copper, &c. It reduces them very rapidly, and, if the metal be not perfectly homogeneous, will faithfully pourtray its imperfections. Manganese, clay, or other foreign bodies, are plainly observable. I would take those three pieces of metal submitted to you for inspection, and subject them to the following treatment:—I would carefully clean them from all grease, with a little turpentine, as grease resists the action of acid on metals, and then immerse about two inches of their length in the acid, which should be slightly warmed, as it "bites" better when tepid. If the acid be too strong, its biting will be rather slow, in which case a little water can be added. After they have been in the acid about ten minutes, the acid will be found to have penetrated to near the sixteenth of an inch, according as the steel is good, bad, or indifferent. They should be then taken out, and carefully immersed in water, to stop the action of the acid, and then examined as to the quantity of carbon each contains, which should be duly notified—a sufficient quantity will be left on the etched steel for this purpose—the carbon undergoing no change from the action of the acid. I would then rinse and dry them; after this they can be safely examined, the faults of each will be plainly palpable. The best will be evenly etched, and dark in colour, from the exposure of the carbon. The next will be more uneven in surface, with more or less of carbon, according to its manufacture. The next, and worst, will be rougher still, "scabby, rough, or rotten," as the case may be. If one should be found to be iron, it will be deeper etched, whitish coloured, and stringy in the grain. These are a few of the distinguishing peculiarities which the acid brings to light. By this process all the properties of steel or iron are exposed. If the steel be "burned," one or two minutes' immersion will be sufficient to detect it,—its surface will be etched in lines considerably apart, corresponding to the patched surface which the steel exhibits previous to polishing.

Purchasers of either iron or steel in large quantities should invariably use it, as no imposition can be exercised without detection. Critical expedients for detecting the qualities of metal are rather numerous—as weight, for instance. No two pieces of metal of exactly equal bulk, if of different qualities, are of the same weight, &c.

By the acid process, it will be seen that either natural or cemented steel can be advantageously subjected to this test in its manufacture. The process of decarbonisation in the former, and of carbonisation in the latter case, instead of being left, as is now done, to the doubtful skill of the workman, can be subjected to the unerring test of the acid. The manufacturer of steel might get a scale of qualities which have been subjected to this test, marked Nos. 1, 2, &c., with such remarks to each piece as may be a guide to the workman—as to the time in its manufacture, the quantity of carbon found, and foreign matter introduced, &c. Such remarks, with the decided peculiarities of each quality of metal, will be a guide to any intelligent workman.

I am, &c.,

THOS. ALMGILL.

MR. BENNOCH'S PAPER ON FIBRE GILDING, &c.

SIR,—In the *Journal of the Society of Arts*, of May the 2nd, I find a letter from Mr. William Green, containing some excellent suggestions respecting the process of gilding threads or fibres.

Mr. Green complains that I "passed so summarily over the origin of fibre gilding in this country." I confined myself to facts realised, and I am not aware that any gilded thread, excepting those I exhibited as specimens—the produce of Mr. Hock's invention—had ever been perfected so as to become a marketable commodity.

* Annals of British Legislation. Smith, Elder, and Co., 65, Cornhill.

However, Mr. Green seems to plume himself more on the presumed fact of priority, rather than in superiority of invention. I regret being obliged to affirm that, as regards priority, the claim is against our country, for, long before the process was completed, the principle was established by Mr. Hock, whose first specimens date years before the date named by Mr. Green.

Perhaps you will permit me to remark that the beauty and simplicity of the invention attracted my attention more than any pecuniary advantage that might result from it, believing that any process of gilding that secured to the manufacturer a thread so flexible as to be readily used with any or every other thread, could not fail to become, some day or other, a great commercial advantage.

I would not willingly depreciate the invention of any man, least of all that of Mr. Green. I am, nevertheless, of opinion, after a careful examination of his specification, &c., that he has yet to prove, not only that his plan is superior, but that it is even equal to that of Mr. Hock, whose process I had the honour to describe.

The more I hear of the subject, the more I am convinced that this discussion will lead to a great impetus being given to this branch of manufacture in the United Kingdom.

I am, &c.,

FRANCIS BENNOCH.

TABLE

OF "MONETARY UNITS" AND THEIR DECIMAL DIVISORS, AS USED IN THE ACCOUNTS OF THE VARIOUS COUNTRIES WHICH HAVE A DECIMAL COINAGE, AND THE APPROXIMATE VALUE OF EACH EXPRESSED IN PENCE AND FRACTIONS OF A PENNY.

	d.		d.
Naples—Ducat.....	66	.....	$\frac{3}{5}$
America—Dollar.....	50	Cent	$\frac{1}{2}$
Sicily—Ducat	42	Bagocchi	$\frac{3}{5}$
Holland—Guilder ...	19	Cent.....	$\frac{1}{5}$
Russia—Rouble	$10\frac{1}{2}$	Copeck.....	$\frac{1}{2}$
France—Franc.....	$9\frac{1}{2}$	Centime	$\frac{1}{10}$
Switzerland—ditto ...	$9\frac{1}{2}$	,, ...	$\frac{1}{10}$
Belgium—ditto	$9\frac{1}{2}$	,, ...	$\frac{1}{10}$
Parma—Lira	$9\frac{1}{2}$	,, ...	$\frac{1}{10}$
Savoy—ditto.....	$9\frac{1}{2}$	,, ...	$\frac{1}{10}$
Sardinia—ditto.....	$9\frac{1}{2}$	,, ...	$\frac{1}{10}$
Greece—Phœnice ...	$8\frac{1}{2}$	,, ...	$\frac{1}{11}$
Venice—Lira	$8\frac{1}{2}$	Centissme	$\frac{1}{11}$
Tuscany—ditto	$8\frac{1}{2}$	,, ...	$\frac{1}{11}$
Portugal—Rees	$\frac{1}{20}$		
China—Cash	$\frac{1}{32}$		

S. O. GRAY.

TABLE

OF MONETARY UNITS, THEIR DIVISIONS, AND THEIR NAMES, AS EXPRESSED IN ACCOUNTS, WITH THE APPROXIMATE VALUE OF THE UNITS, AND OF THE SMALLEST COIN OF ACCOUNTS OF EACH, EXPRESSED IN ENGLISH MONEY AND DECIMALS OF A PENNY.

		s.	d.		d.
Great Britain.....	Pound	20	0	=20 Shillings, 12 Pennies, 4 Farthings...	960=.25
Prussia	Thaler.....	3	0	=30 Groschens, 12 Pfennings	360=.1
Hanover.....	,, ...	3	0	=24 Gute Groschens, 12 Pfennings	288=.125
Bremen	Rixdollar	3	3	=72 Grotes, 5 Schwaren	360=.10844
India—Bengal	Rupee.....	2	0	=16 Annas, 12 Pice	192=.125
Bombay.....	,, ...	2	0	= 4 Quarters, 100 Reas	400=.06
Bavaria	Florin.....	1	8	=60 Kreutzers, 4 Pfennings	240=.08333
Austria	,, ...	2	0	=60 Kreutzers, 4 Pfennings.....	240=.1
Hamburg	Mark	1	6	=16 Skillings, 12 Pfennings	292=.09376
Sweden	Rixdaler.....	1	8	=48 Skillings, 12 Rundstycken	576=.03472
Denmark	Rigsbank Dollar	2	$2\frac{1}{2}$	=96 Skillings.....	96=.27604
Spain	Real de Vellon	0	$2\frac{1}{2}$	=34 Maravedis	34=.07353
Turkey	Piastre	0	$2\frac{1}{4}$	=40 Paras	40=.05625
Egypt.....	,, ...	0	$1\frac{1}{3}$	=40 Paras	40=.08331
				Aggregate	1d.=.56940

Average .1121, or nearly $\frac{1}{10}$ d. $\cdot\frac{1}{4}$

S. O. GRAY.

British Museum.

ON TAKING PHOTOGRAPHIC IMAGES UNDER WATER.

SIR,—Mr. Penney, of Poole, has forwarded to me your communication.

I accordingly enclose you a positive copy, from a negative collodion plate, of a view of a portion of Weymouth Bay, taken at a depth of three fathoms.

The plan I adopted was very simple.

Mr. Kenyon, of this place, and myself, were weather-bound for a few hours at the Portland Ferry Bridge House, and in a room looking on the Fleet water, that was running like a mill-stream through the bridge, within thirty yards of our window.

I was musing, as persons in our then unfortunate condition (namely, weatherbound, and two miles from home and dinner) will muse; and my thoughts wandered to the effect the great force of the Fleet water would have on the piles of the bridge. I passed in review the piles carried away; and the diver's aid called in to examine the amount of submarine damage, and the difficulties and expense which necessarily follow; and the idea occurred to me that the camera might considerably assist us.

I mentioned the idea at once to my friend Mr. Kenyon, and we agreed to test its value at the earliest opportunity. We partially succeeded at our first and only attempt, but non-amateur occupation has, for the present, prevented my further experimenting.

I will now give you an outline of the plan on which I proceeded.

I knew that, could we sink a glass plate, prepared with collodion, to the bottom of the sea, in theory there was no reason why we should not obtain as good an image as we do on land, provided the sea water could be kept from the camera, and that the light was sufficient. I was not sufficiently versed in optics and chemistry to know whether or not the water obstructed any and what light rays.

Following my idea, we made a box as nearly water-tight as we could, and large enough to enclose the camera.

This box is fitted, in front with a piece of plate glass, and on the outside is a wooden shutter, heavily leaded, and which is raised by a string attached to it and communicating with the boat.

On each side of the box is an iron band, terminating in a screw, and projecting beyond the back, which is loose, and fitted with an iron bar, having a hole at each end, through which the screws of the band pass, and thus the back is screwed down tight against the body of the camera by means of a nut; the inner surface of the back is padded, so as to make the camera box, as far as possible, water-tight, when the back is screwed into its place.

The box is fixed to an iron tripod, and a band, with an eye on its upper margin, is passed round both camera, box, and stand; to this eye is attached the rope that lowers the camera to the sea bottom, and by which it is raised. This is the whole of the apparatus employed.

The first thing to be accomplished is to focus the camera, which is done as follows:—The camera is placed in the box on the shore, and a view is focussed, taking as the foreground an object at ten yards distance. This I did with the view now sent, but I fear it is too much. I then fix the stand by means of a triangular wooden frame forced up between the legs of the tripod stand, and which is prevented from slipping down by being attached to the top of the tripod by a line; this keeps the camera frame the exact distance from the ground that it was when focussed on land, and the camera being focussed for the same distance, it stands to reason that, provided the optical and chemical properties are the same, we shall obtain a similarly good picture.

The next thing to be done is to prepare the plate and enclose it.

The plate is prepared with collodion, in the usual way, under a tent. It is then placed in the camera (my camera used for this purpose takes a plate 5 in. by 4 in). I then take the camera to the box and stand, and throw a black cloth over all. I examine the shutter in front of the camera box to see that it is tight; then, uncapping the camera under the cloth, I place it in the box, and finally draw up the slide. I then push the camera completely into the box, until the front of the lens presses against the plate glass front of the box, and screw on the back tight. The camera is thus, light tight, and properly focussed; and nothing remains to be done but to lower it to the bottom of the sea.

Up to the present point everything has been done on land. We now lash the whole of the apparatus, properly set, to the stern of the boat, and, when we arrive at the proper spot, sink the camera. By means of the lowering rope we can find when the camera is upright at the bottom. When satisfied on this point, we raise the shutter in front of the camera box, by means of the string attached to it, and the other end of which communicates with the boat. The camera is now in action.

The time I allowed for my negative was ten minutes, and you will perceive it is a weak one. It took some time to develope with 3 grains of pyro-gallic acid to the ounce.

There are one or two points worthy of notice as having occurred in the experiment. The first is, that the image is formed on the plate in its natural position, and not inverted. From this it would appear that the piece of glass in front of the camera box, and the water conjointly, act in the same way as a parallel mirror.

Another fact is, that the salt water does not materially injure the plate. With all my care, the great pressure at the depth to which I sunk my camera forced the water into the camera itself, and covered the collodion plate. When I opened the camera and found it full of water, I despaired of having obtained a view; but it would appear that salt water is not so injurious as I had feared. I took the precaution of washing the plate gently with fresh water, and then of dipping it for an instant in the silver bath. The plate was exposed for ten minutes on an ordinary day in the month of February; it took nearly the same time to develope with pyro-gallic acid, using Horne and Thornthwaite's collodion; you will see the negative is a weak one.

I would draw your attention to the line of demarcation between the water and air, which is very visible. The plate was the second one I tried; the first I exposed for five minutes, and obtained no image; and by the time I exposed the one I now send, the light had become very bad. I have not since made a trial, although I have had a better apparatus constructed. The view was taken in a nook of the bay of Weymouth, which is bounded by a ridge of rocks not rising in ordinary tides to nearly the surface of the water. The area within is of sand and boulders, and thickly clothed with sea weeds, such as *Laminaria saccharina*, *Chondrus crispus*, *Ryliphlæa*, and many other species. This will assist you in deciphering the photograph.

This application of photography may prove of incalculable benefit to science. We may take (to a reasonable depth) sketches of submarine rocks, piers of bridges, outlines of sand-banks, in fact, everything that is required under water. Should a pier of a bridge require to be examined, you have but to suit your camera, and you will obtain a sketch of the pier, with any dilapidations; and the engineer will thus obtain far better information than he could from any report made by a diver.

My object in studying photography is in order to illustrate objects of Natural History, as I unfortunately cannot use my pencil. I enclose you a sketch of the lump fish, *Cyclopterus lumpus*, caught on the Chesil beach, and which is not a common fish.

I am, &c.,
WILLIAM THOMPSON.

Weymouth, May 6, 1856.

ENGLISH AND FRENCH SURGICAL INSTRUMENTS.*

SIR,—In Mr. Dunn's speech, at the close of the meeting last Wednesday, he made a statement that is quite astounding. He said, the French have a description of manufacture we have never attempted, viz. surgical instruments; and that, however well they may be made here, nothing is so highly esteemed by English surgeons as a French instrument. Now, if the French instruments are so much desired by the English profession, they can easily please their fancy; for the duty is so trifling, that it is no impediment. But the very reverse is the fact; and were it not for the high protective duty in France, English instruments to a great amount would be sent there. Indeed, English instruments, as well as cutlery, have now, and always have had, a world-wide repute.

I am, &c.,
R. WILLIAMS.

62, Strand, 16th April, 1856.

Proceedings of Institutions.

BELFAST. — The Annual Meeting of the Working Classes' Association, for the past year, took place on the 28th of February. From the Report read by the secretary, the following particulars have been selected:—The year's receipts for news-room and library amounted to £250 7s. 8d.; expenditure, £239 16s. 9d., leaving in the Treasurer's hands a balance of £10 10s. 11d. During the year, 271 new Subscribers had availed themselves of the privileges of the Institution, raising the total considerably above that of the year preceding. It appeared, moreover, that books of a more utilitarian character had latterly taken the place of low fiction; and that a demand for History, Biography, and Science, was increasing among the people generally. The Report alluded to two valuable donations of books, presented to the Association by Sir J. E. Tennent, and H. M. Cairns, Esq., M.P. —in consequence of which the shelves of the Library had to be considerably extended. It also referred to the

* It will be observed, from the date of this note, that its publication has been unavoidably delayed.—SEC. S. OF A.

very favourable results of a lecture on "The Northmen," delivered on behalf of the Association's Library, by Right Hon. Lord Dufferin and Cladeboye. It noticed the addition of several of the higher-class periodicals—such as the "Westminster," "Quarterly," "Irish Quarterly," and "Edinburgh" Reviews, to the tables of the Reading-room; and spoke in a confident tone of the Institution being in a fair way of attaining to a self-supporting position. Having gone, with much minuteness, through a variety of details and statistics, the Report concluded with an appeal to the Members, to consider the necessity of their united exertions to provide for the Association a building of more ample accommodation than had been possessed hitherto. It called upon them to consider of what utility to the common weal of such a town as Belfast, might be a building capable of affording means and accommodation for the establishing of public classes, such as had been productive of so much success in several Institutions of a similar character, throughout the empire. The appeal having been responded to with unanimity, and a number of minor resolutions passed, the Meeting separated.

LIVERPOOL.—In the month of April four public Lectures on Zoology were delivered at the Collegiate Institution, by Professor Owen. The first lecture was on "Fossil and Extant Fishes;" the second on "Reptiles and their Range in Space and Time;" the third "On Birds;" and the fourth "On the Mammalia, more especially on the Ruminants and their use to Man."

To Correspondents.

ERRATA.—P. 404, col. 2, line 31, after "engraved rollers," take out the semicolon, and insert a semicolon after "purpose," in line 32; and in line 40, take out "but."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Delivered on 26th and 28th April, 1856.

Par. No.
92. (1) Masters (Navy)—Supplemental Nominal Return.
162. Salted Provisions (Navy)—Returns.
171. Exchequer Bills—Return.
39. Trade and Navigation Accounts (31st March, 1856).
167. Merchant Seaman's Fund—Account.
104. Bills—St. Sepulchre's Manor (Dublin).
106. Bills—Grand Jury Assessments (Ireland).
108. Bills—Commissioners of Supply (Scotland) (as amended in Committee and on Re-committment).
109. Bills—Rating of Mines.
Eastern Papers (Christian Privileges in Turkey)—Part 18.
Kars—Supplementary Papers.
Normal Schools—Reports.
Central America—Correspondence.

Delivered on 29th April, 1856.

41. Local Acts (28. Broadstairs Harbour, Pier, and Landing-place)—Admiralty Report.
120. Trade and Manufactures (Scotland)—Return.
Convict Prisons (Ireland)—2nd Report of the Directors.
Treaty of Peace—Protocols of Conferences held at Paris.
Maritime Law—Declaration.
Re-establishment of Peace—General Treaty.

Delivered on 30th April, 1856.

153. Hops—Account.
172. Metropolis Turnpike Roads—30th Report of the Commissioners.
111. Bills—Procedure and Evidence.
112. Bills—Whichwood Forest (as amended by the Select Committee).

Delivered on 2nd May, 1856.

173. Stamps (Court of Chancery) (Ireland)—Return.
175. Tithes—Return.
176. Barracks (Cavalry and Infantry)—Return.
113. Bill—Coalwhippers (Port of London).
Turnpike Trusts—5th Report by the Secretary of State.

Delivered on 3rd and 5th May, 1856.

180. Valuation (Ireland)—Returns.
182. Home-made Spirits—Account.
184. National Debt—Return.
191. Army Estimates (Original and Reduced Amounts)—Statement.
65. Fisheries Board (Scotland)—Copy of Treasury Minute.
183. Spirits (Ireland)—Returns.
185. Fishery Harbours (Ireland and Scotland)—Return.
187. Incumbered Estates Court (Ireland)—Return of Purchases.
188. Incumbered Estates Court (Ireland)—Return of Number of Petitions.
192. Committee of Selection—6th Report.
103. Bills—Spirit Trade (Ireland).
117. Bills—Juvenile Convict Prison (Ireland) as amended by the Select Committee).
114. Bills—Testamentary and Matrimonial Jurisdiction.
115. Bills—Sleeping Statutes.
118. Bills—Scientific and Literary Societies.
119. Bills—National Gallery (amended).
121. Bills—West India Loans.
United States—Papers relative to Recruiting.
Salt in British India—Report of the Commissioner.
Salt in British India—Appendix to Do.
Salt in British India—Maps and Plans.
Japan—Correspondence.
Education (Schools of Parochial Unions)—Minutes of the Committee of Council.
Trade of Foreign Countries—Abstract of Reports.
Ottoman Empire—Treaty.

MEETINGS FOR THE ENSUING WEEK.

MON. Geographical, 8½, 1. Renewed discussion on "The Central America Canal:" 2. Captain Stokes, R.N., "Steam Communication with the Australian Colonies and the Cape of Good Hope;" 3. Mr. R. Wallace, "Journey up the Sadong River, in Borneo."

TUES. Royal Inst., 3, Mr. T. A. Malone, "On Photography."
Syro-Egyptian, 7½, Mr. Joseph Bonomi, "Reasons for believing that certain Egyptian Pictures and Sculpture contain Representations of a Tribe of the Amakims, mentioned in Scripture."
Civil Engineers, 8, Discussion on Mr. Murray's paper "On the Progressive Construction of Sunderland Dock."
Medical and Chirurgical, 8½.
Zoological, 9.

WED. Literary Fund, 3.
London Inst., 3, Professor Rymer Jones, "On Entomology, and the General Organisation and Metamorphoses of Insects."
Royal Society, Literature, 4½.
Society of Arts, 8, "Professor Clark, "On Means available to the Metropolis and other places for the Supply of Water free from Hardness and from Organic Impurity."
Graphic, 8.
Ethnological, 8½.

THURS. Royal Inst., 3, Prof. Tyndall, "On Light."

FRI. Society of Arts, 8, Extra, Renewed discussion upon Mr. Braidwood's paper on "Fires; the Best Means of Preventing and Arresting them, with a Few Words on Fire-roof Structures."
Royal Inst., 8½, Dr. A. W. Hofmann, "On Ammonium."

SAT. Asiatic, 2, Anniversary.
Royal Inst., 3, "Dr. A. W. Hofmann, "On the Non-Metallic Elements, their Manufacture and Application."
Royal Botanic, 3¾.
Medical, 8.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette May 2nd*, 1856.]

Dated 2nd April, 1856.

791. Frances Young, Norwich—Improved two-wheeled open vehicle or carriage.

Dated 9th April, 1856.

858. Richard Chrimes, Rotherham—Improvements in buffers and other springs for railway and other carriages.

Dated 11th April, 1856.

866. Henry Henderson, Glasgow—Improvements in water-closets.
870. Peter Armand le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Improved apparatus for measuring the speed of currents of air and water. (A communication.)
872. Robert Davis, 267, Oxford-street—Improvements in the construction of tobacco-pipe stems.

Dated 12th April, 1856.

874. James Nash, Manchester—Improvements in the fusible plugs and furnaces of steam-boilers.
876. Robert Stirling Newall, Gateshead-upon-Tyne—Improvements in telegraphic insulators.
878. Francisco Nuibo y Pedros, 39, Rue de l'Echiquier, Paris—A new motive power.

Dated 14th April, 1856.

880. Edwin Heywood, Sutton, near Keighley—Improvements in fixing apparatus for generating steam, whereby smoke will be prevented or consumed, and fuel economized.
882. Patrick Robertson, Shawlands-hill, Renfrew—Improvements in power-loom weaving.
884. Robert Richardson, Great George-street, Westminster—Improvements in railway switches.
886. Louis Pierre Coulon, 39, Rue de l'Echiquier, Paris—A new type-distributing and composing machine. A communication.)

888. Joseph Barrans, New-cross, Deptford—Improvements in constructing steam-engines.
890. William Warren, Northampton-park, and Warren De la Rue, Bunhill-row—Improvement in the manufacture of envelopes.
892. Leonard Kaberry and Aaron Horsefield, Rochdale—Improvements in moulding for casting certain parts of machinery used in the preparation and spinning of cotton and other fibrous materials.
894. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of constructing grate-bars. (A communication.)

Dated 15th April, 1856.

896. William Henry Olley, 2, Brabant-court, Philpot-lane—Taking photographic impressions or pictures of microscopic objects by reflection, such reflection being effected by the combined aid of the microscope and camera obscura and camera lucida or other reflectors that may be employed in place of the latter.
898. Thomas Jeffries, Reading—Improvements in cooking-stoves.
902. William Fuller, Jermyn-street—Improvements in ice pails.

Dated 16th April, 1856.

904. Edwin Napoleon Norminton, 12, Charrington-street, St. Pancras—The manufacturing of railway grease for the cleansing and remanufacturing of old used dirty railway grease or greases, for the cleansing and remanufacturing of old dirty cotton waste, tow, or any textile fabric.
906. David Blair White, M.D., Newcastle-upon-Tyne—Improvements in cylinder pistons or plungers.
908. Alfred Vincent Newton, 66, Chancery-lane—Improvements in fire-arms and powder flasks. (A communication.)
910. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in cleansing and hulling grain and seeds, and in the machinery or apparatus employed therein. (A communication.)
912. William Little, Strand—Improvements in lamps for burning paraffine and bituminous oils or napthas.

Dated 17th April, 1856.

914. Charles Hulme, Samuel Ivers, and John Yardley, Farnworth—Improvements in power-looms for weaving.
916. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of tyres. (A communication.)
918. Samuel Eyre, Bouverie-street—Improved application of portable mirror.
920. John Skirrow Wright, Birmingham—Improvements in the construction and ornamentation of belt or band fastenings.

Dated 18th April, 1856.

922. William Westley, Willington, Derby—Improved nail or spike.
924. John Marsh, Burnt Tree, near Dudley—Improvements in fire-grates.
926. Charles Frederick Stansbury, 67, Gracechurch-street—Improved mode of splicing and fastening the adjacent ends of the rails of a railway track. (A communication.)
928. Uriah Scott, Camden-town—Improvements in metal fittings for furniture.
930. Thomas Walker, Birmingham—Improvements in governors or regulators of steam and other motive-power engines.
932. Julius Jeffreys, Kingston-hill—Improvements in instruments for aiding respiration.
934. Josiah George Jennings, Great Charlotte-street, Blackfriars-road—Improvements in pumps.

Dated 19th April, 1856.

938. Edmund Hunt, 31, Walnut-tree walk—Improvements in Hansom cabs and similar vehicles, parts of which improvements are also applicable to other carriages.
940. William Adkins, Smallbrook-street, Birmingham—Measuring fabrics which he proposes designating the automaton measurer or draper's assistant.
942. William Jean Jules Varillat, Rouen—Improvements in the apparatus for the extraction of colouring, tanning, and saccharine matters from vegetable substances.
944. Abram Longbottom, Moorgate-street—Improved means of lighting and ventilating mines.
946. François Jean Bouwens, Malines, Belgium—A new rotative steam-engine.

Dated 21st April, 1856.

948. James Nasmyth, Patricroft, near Manchester, and Herbert Minton, Stoke-upon-Trent—Improvements in machinery or apparatus employed in manufacturing tiles, bricks, and other articles from pulverized clay.
950. Jules Dortet, Paris—Improved padlock.
952. Joseph Auguste Marie Touet Chambor, Paris—Improvements in fire-places.
954. James Hansor, 2, Portland-place, Wandsworth-road—Improvements in the manufacture of illuminating gas.

Dated 22nd April, 1856.

956. John Thomas Stroud, Suffolk-street, Birmingham—Improvements in stop cocks or taps for regulating or cutting off the passage of gas to combined gas burners.
958. Alexander Symons, George-street, Mansion-house, and Edward Burgess, Clerkenwell-green—Improvements in apparatus for producing alarums to indicate burglary by means of electricity.
960. Alfred Vincent Newton, 66, Chancery-lane—Method of obtaining purified oil from coal, shale, and other bituminous substances. (A communication.)
962. William Smith, Woolston, Fenny Stratford—Improvements in constructing and applying windlasses for working ploughs and other agricultural implements.
964. David Lloyd, Ebbw Vale Iron Works, South Wales—Improvements in washing minerals, coal, and ores.
966. Thomas Evans Blackwell, 1, Cornwallis-grove, Clifton—Improvement in treating water for the use of brewers.
968. Richard Archibald Brooman, 166, Fleet-street—Improvements in or connected with centrifugal machinery. (A communication.)

Dated 23rd April, 1856.

970. George Forster, Standish, near Wigan—Improvements in the arrangements of "trap-doors" or "air-doors" and their cases in the workings or passages in mines, whereby the efficient ventilation is maintained, which said improvements are also applicable in other similar situations.
972. James Garnett, Low Moor, Clitheroe—Improvements in twisting, winding, and reeling yarn, and in machinery or apparatus employed therein.
974. Thomas Squire and Charles Frederick Claus, Latchford—Improvements in the manufacture of artificial manure.
976. William Henry Balmain and Thomas Colby, St. Helen's—Improvements in the manufacture of alkalies from their sulphates.
978. Peter Ward, Patent Alkali Works, St. Helen's—Improvement in furnaces used in the manufacture of alkali.

WEEKLY LIST OF PATENTS SEALED.

Sealed May 1st, 1856.

2445. William Henry Walenn.

Sealed May 2nd, 1856.

2452. Werner Staufen.
2457. James Heginbottom.
2478. Henry Clinton Page.
2488. Joseph Jessop.
2489. Frederic Ludewig Hahn Danchell.
2491. Joseph Schloss.
2496. George Cotsell.
2500. Frederick Scholefield.
2503. William Davis.
2563. William Barnes.
2587. James Yates and Thomas Rawlins Birch.
2600. John Fleetwood.
2647. John Elce and George Hammond.
2648. Samuel Ratcliffe Carrington.
2661. Frederick Osbourn.
2677. John Henry Johnson.
2684. George Richardson.
2855. John Henry Johnson.
2860. John Pierrpont Humaston.
79. John Erskine.
86. William Pole and Frederick William Kitson.
178. William Johnson.
302. Matthew Whiting, jun.
376. Thomas Parkinson Capp.
578. David Yoolow Stewart.

Sealed May 4th, 1856.

2499. Joseph Haley.
2523. Henry Fletcher.
2534. Henry Wickens.
2536. Jules César Alexandre Bouillotte.
2537. Louis Joseph Frédéric Marguéritte.
2540. George Cooke.
2541. Thomas Hitt.
2557. Robert Murdoch.
2645. John Jobson.
155. Charles Robertson.
169. Edward Lawson and George Jennings.
215. William Spurrier.
387. Thomas Evans Blackwell.
420. William Gwillim Merrett.
453. Frederick William Mowbray.
469. James Warburton.
473. Charles Brook, jun., and Joseph Hirst.
503. Edward Ellis Allen.
533. Alfred Francis.
535. Cyprien Marie Tessié du Motay and Jean Jacques Fontaine.
553. George Lodge, sen., John Ogden, and George Lodge, jun.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

April 29th.

1075. Richard Quin.
1094. John Scott Russell.
1121. Christopher Nickels.

April 30th.

1080. Frederick Arnold.
1151. John Henry Johnson.

May 1st.

1057. Henry Constantine Jennings.
1061. George Murton and William Hatton Langshaw.
1097. William Edward Newton.
1125. James Nichol.
1285. William Edward Newton.
303. William Henham.
1336. George Goodlet.

May 2nd.

1095. Charles Goodyear.
1109. Thomas Symes Prideaux.

May 3rd.

1116. John Ryan Danks and Bernard Peard Walker.
1156. Marie Pierre Ferdinand Mazier.
1186. Richard Archibald Brooman.
1223. Bernard Peard Walker and James Warren.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3833	May 6.	Street Gully, or Stench and Sediment Trap	John Michael Butt and Co.	Kingsholm Iron Works, Gloucester.
3834	May 7.	Improved Invert Block for Sewer or Conduit Bottoms	Joseph Cliff	Wortley, near Leeds.